

VOLUME 14

PART 2

MEMOIRS
OF THE
QUEENSLAND MUSEUM

BRISBANE



VOLUME 14

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OF THE
QUEENSLAND MUSEUM

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VOLUME 14 PART 2

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THE APPLICATION OF THE GENERIC NAME *MACROPUS* SHAW
1790 AND OF OTHER NAMES COMMONLY REFERRED TO
THE GREY KANGAROO

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There has been considerable discussion in recent years as to the identity of the kangaroos collected in the vicinity of the Endeavour River, north-east Queensland in 1770 by Captain James Cook's party. Three specimens were obtained, weighing respectively 8, 38 and 84 pounds. From an account of this material, Muller (1776) described the kangaroo (*Mus canguru*) mentioning only the 38 pound specimen. This is the holotype of *Mus canguru* Muller and it has been generally accepted that the specimen was a grey kangaroo.

Iredale and Troughton (1925), as a result of examining the description contained in Solander's unpublished manuscript (1768-1771), expressed doubt that the original specimen described and named *Mus canguru* by Muller (1776) was a grey kangaroo. They suggested that it might have been a wallaroo of the *robustus* group. Later, the same authors (1937) endeavoured to show that it was really a whiptail or pretty-faced wallaby (*Wallabia elegans*). Again, this conclusion was based on Solander's manuscript, aided by the purchase of two skins collected near Cooktown on the Endeavour River, one a whiptail wallaby and the other an antilopine wallaroo. It is difficult to understand this decision. Solander's description is a composite one; parts of it (one of the weights, some measurements, a sex) can clearly be related to the holotype, while other parts have been taken from other specimens.

Raven (1939) then discussed the matter and held that the earlier revisers were correct in indentifying the first described specimen as a grey kangaroo. Morrison-Scott and Sawyer (1950) provided excellent support for this view, and they produced additional pertinent evidence that the type of *Mus canguru* Muller was a young grey kangaroo. These authors published (1) two outline sketches (indeterminable*) of an entire kangaroo made by Parkinson, artist on board the *Endeavour*; (2) wash

* We have examined a coloured transparency (supplied through the Mitchell Library, Sydney) of a painting of a kangaroo by Stubbs which is probably the original of the figure in Hawkesworth (see Lysaght 1957). We are unable to identify it specifically with any species which nowadays occurs at Cooktown. Any attempt to establish that this figure and painting are of the holotype would be pointless. Muller specifically nominated the holotype by reference to its weight and there is no evidence that this figure represents the nominated animal.

drawings by Nathaniel Dance of a skull, which can be identified as that of *Macropus robustus*, a grey wallaroo; and (3) a photograph of a skull of a young grey kangaroo which they designated the "photo-lectotype" of *Macropus kanguru* (Muller). This last skull was collected on Cook's voyage and was given to John Hunter by Banks, a member of Cook's party. It is No. 1732 in Owen's catalogue (1853) and No. 3703 in Flower's catalogue (1884). It is the skull of a young grey kangaroo and we believe that it is from the 38 pound specimen collected near the Endeavour River. Both Owen and Flower described this skull and its dentition.

Morrison-Scott and Sawyer have suggested that the largest of the three specimens collected, weighing 84 pounds, was a wallaroo of the *Macropus robustus* group, and now represented by the Dance drawings. The presence of a specimen of the wallaroo in Cook's collection would account for the statement by Solander in his composite description that the internarial area of the kangaroo was naked. A juvenile grey kangaroo from Cook's voyage (presumably the specimen which weighed 8 pounds) was recorded by Gray (1843) as being preserved in spirits in the British Museum. It is no longer in the collections. The skull of the third animal, which was in the collections of the Royal College of Surgeons in London, was destroyed by a bomb and is now represented by a photograph in the British Museum and undoubtedly it is the skull of a young grey kangaroo, shown by us here to be from an animal weighing in the vicinity of 38 pounds, and certainly not 84 pounds.

The instability which now exists in the nomenclature of these well known kangaroos and wallabies is undesirable and can best be removed by proving the specific identity of the holotype which was nominated by Muller. Clearly, no consideration need be given to the 8 pound juvenile grey kangaroo which was in the British Museum; the holotype is either the Hunterian specimen or another, probably represented by the specimen drawn by Dance. It must be emphasised that Solander's composite description which was not published until 1925 is of no nomenclatural importance.

TOPOTYPICAL MATERIAL

Morrison-Scott and Sawyer lacked material from the type locality, and with this in mind, a party from the Queensland Museum, consisting of D. P. Vernon, S. Breeden and M. E. McAnna, collected in the vicinity of Cooktown, Endeavour River, during October and November, 1960. Among the specimens obtained are five grey kangaroos, seven grey wallaroos, six antilopine wallaroos, seven whiptail wallabies and ten agile wallabies.

A young male grey kangaroo (J.10749), collected at Kings Plains, November 24, 1960, by Vernon and Breeden, is nearest in weight to the 38 pound animal of the *Endeavour* party. Although it weighed 55 pounds, including viscera and stomach contents, its dental age is precisely that of the 38 pound animal. Another male

(J.10750), weighing 90 pounds, including viscera and stomach contents, was collected at the same locality. This specimen has all molars fully erupted, and not only has dP⁴ been shed, but its successor (P⁴) also has been shed on the right side and is close to being shed on the left. It will be clear from these remarks that the 84 pound *Endeavour* specimen cannot have been the skull given by Banks to Hunter, and on the evidence afforded by the specimen (J.10749) in the Queensland Museum, it must have been the 38 pound animal. Furthermore, in addition to agreeing exactly in dental age, the limb measurements of the young male (J.10749) alone agree closely with those provided by Muller when describing *Mus kanguru*.

The exact stage of dental eruption reached by the Hunterian (38 pound) specimen was well described by both Owen and Flower. P³ has been shed, dP⁴ was about to be replaced by P⁴; M¹, M² and M³ were in place in the maxilla and M⁴ was still in its crypt. The dentition of J.10749 is the same as will be seen from the accompanying plates.

It was not possible to establish on the recent Cooktown material the range of variation in weight which can be expected at this stage of dentition. However, for this purpose, Mr. W. H. Butler, Associate of the Western Australian Museum, collected a series of male grey kangaroos from a single population at Congelin, south-west Australia. Three of these were at the same dental age as both of the above, and their weights were 63, 68 and 79 pounds, a weight range of 16 pounds. The south-west grey kangaroo is a heavier animal than the north-east Queensland form, but the difference in minimum and maximum weights is similar to the difference between the 38 pound specimen of Cook's party and the Queensland Museum example, J.10749. It would appear that the 17 pounds difference is not significant.

Finally, in order to satisfy ourselves as to the probability of the identification of the skull of the Dance drawing with the 84 pound specimen, this (as reproduced in Morrison-Scott and Sawyer) has been carefully compared with skulls from the Endeavour River of the whiptail wallaby, the agile wallaby, the antilopine wallaroo, the grey wallaroo and the grey kangaroo, and it is clearly a specimen of the grey wallaroo. At first sight, the third upper incisor appears unusual until it is realised that Dance, in order to show the presence of the faint groove in the outer surface of the posterior lobe, has slightly overemphasized it. The skull drawn by Dance has a sectorial tooth followed by three fully erupted molariform teeth, and a partly open alveolus is shown behind the last molariform tooth. The cementum area of the root of the third incisor is well exposed and the pronounced supraorbital crests become confluent above the temporal fossa to form a sagittal crest. These growth characters support our identification of the teeth as P⁴, M¹, M², and M³ (with M⁴ in its crypt). Hawkesworth says of the 84 pound animal, that it was "not at its full growth, the innermost grinders not yet being formed." A male specimen of the grey wallaroo at this dental age (J.10738) was collected at Annan River, 17 miles south of Cooktown and it weighed 70 pounds.

The skull of the wallaroo drawn by Dance is very probably that of the 84 pound animal shot by Lieutenant Gore on July 27th, 1770. Its presence in the series would explain the presence of the characters which are atypical of the grey kangaroo in the composite description of Solander (e.g. the naked internarial region). The grey wallaroo is the only "grey" macropod in the area which possesses these characters and at the same time achieves a weight of 84 pounds. Further it should be noted that, of the five species collected at the Endeavour River in 1960, the male grey wallaroo is the only male form which is sufficiently nondescript externally to be included with a series of grey kangaroos without remark. Cook's party obtained two grey kangaroos, and male specimens of species other than the grey wallaroo are either widely different from the grey in colour or are, even to the untrained eye, brightly and obviously ornamented.

WHIPTAIL WALLABY

It has already been stated that the final decision of Iredale and Troughton that *Mus kanguru* Muller was based on a whiptail wallaby was not derived from an examination of Muller's description, but from an examination of a description contained in a manuscript by Solander, now in the British Museum. This description included both the male and female genitalia and the pouch, and the weights of three animals were given. The main characters stated by Solander and used by Iredale and Troughton were that the area between the nares was naked and that the third incisor was bilobed, broad from side to side and with smaller anterior lobes. As Morrison-Scott and Sawyer have pointed out, Solander's description of the incisors accords neither with the grey kangaroo nor the whiptail wallaby, but it is in accord with the condition in the wallaroo.

Solander also stated "Par intimum Molarium diu intra alveolus suis latet, in junioribus non discernendum," implying that both the 38 and 84 pound specimens had unerupted last molars. He referred to the 38 pound example as a male of two or three years, and to the 84 pound animal as "adultus." Similarly, Hawkesworth described the 38 pound animal as "a young one, much under its full growth." Elsewhere in the same work Hawkesworth made it clear that the term "full growth" referred to the possession of fully erupted molar teeth since he said of the 84 pound animal "We found that this animal was not at its full growth, the innermost grinders not being yet formed."

All male whiptail wallabies between 30 and 50 pounds in weight collected on the recent field trip to the Endeavour River had erupted last molars, as was to be expected. Externally, each individual has a prominent white stripe, approximately

12 mm. wide, extending from the nares to behind the eye on each side of the face ; another prominent white stripe, crescent-shaped, on each thigh ; and the fur under the head, centre of throat and entire abdomen is white. It is most unlikely that those who examined and described the first collected Macropodidae from Australia would ignore these vivid markings if the whiptail wallaby was represented in the collection.

CONCLUSION

From the above evidence, together with the evidence provided by Morrison-Scott and Sawyer, it would appear that the following specimens were collected in the vicinity of the Endeavour River, north-east Queensland, in July, 1770 by Cook's party.

- (1) A grey wallaroo, *Macropus robustus*, weighing 84 pounds. It is likely that from this specimen Solander in manuscript described the area between the nares as naked. Now apparently represented by a wash drawing of the skull by Nathaniel Dance in the British Museum.
- (2) A young grey kangaroo, weighing 38 pounds. This specimen, which had P⁴ and M⁴ still in their crypts, was described by Hawkesworth (1773) and described and named *Mus canguru* by Muller in 1776. Now represented by a photograph of the skull in the British Museum.
- (3) A juvenile specimen, weighing 8 pounds, a grey kangaroo. Recorded as preserved in the British Museum (Gray, 1843), but not now in the collections.

CONSERVING THE GENERIC NAME *MACROPUS*

Macropus is currently the generic name of the large-sized kangaroos, including the grey kangaroo, and it has been applied in this way for more than one hundred years. The genotype is *Yerboa gigantea* Zimmermann (1777) which is accepted as a synonym of *Mus canguru* Muller (1776).

The view of Iredale and Troughton is that the type of *Mus canguru* Muller was a whiptail wallaby, at present generally known as *Wallabia elegans*. To those who accept this view, the generic name *Macropus* must be used for the large-sized wallabies, and another name will have to be found for the large-sized kangaroos.

Since the case presented here rests, to some extent, on probability, in order to stabilize both the generic and specific names involved, we have decided to approach the International Commission for Zoological Nomenclature with the following request :—

- (1) That the specimen, the skull of which was given by Sir Joseph Banks to John Hunter and became No. 3703 in the collections of the Royal College of Surgeons, London, be declared the holotype of *Mus kanguru* Muller 1776; that since this specimen has been destroyed, it be replaced by a neotype, a grey kangaroo, Queensland Museum No. J.10749, male, skin and skull, collected at Kings Plains, 20 miles south of the Endeavour River, November 24, 1960, by D. P. Vernon and S. Breeden.
- (2) That a procedure be adopted to make the name *Yerboa gigantea* Zimmermann 1777 an objective synonym of *Mus kanguru* in accordance with the current usage of these two names.
- (3) That the name *Macropus major* Shaw 1800 be conserved for the grey kangaroo with type locality Sydney as restricted by Iredale and Troughton (1934). According to Article 72d of the International Code, *Macropus major* has the same type specimen as *Yerboa gigantea* and the Plenary Powers will have to be exercised in order to validate the action of Iredale and Troughton.

If the Commission accepts this recommendation, the generic name *Macropus* will continue to be available for the large-sized kangaroos; *M. kanguru* will be the name of the grey kangaroo; and *major* will be available for the grey kangaroo of Sydney and beyond should it prove to be subspecifically distinct from the Endeavour River, north-east Queensland grey kangaroo.

It is a pleasure to acknowledge the assistance rendered by the staff of the Mammal Department, British Museum (Natural History), in particular Miss Jean Ingles and Dr. Gordon Corbet; the Fisheries and Wildlife Department, Victoria, especially Mr. John McNally; Mr. E. H. M. Ealey of the Department of Zoology and Comparative Physiology, Monash University; and Mr. W. H. Butler, Associate of the Western Australian Museum.

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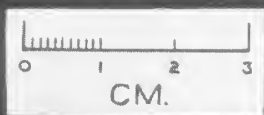
EXPLANATION OF PLATES

Macropus canguru, Grey Kangaroo

- Plate V. Dorsal view of skull.
- Plate VI. Ventral view of skull.
- Plate VII. Lateral view of skull.
- Plate VIII. Mandible.

All views of same skull, J.10749, male (Q.M.). All natural size.

Specimen from Kings Plains, 20 miles south of Cooktown, N.E. Queensland.



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J10749

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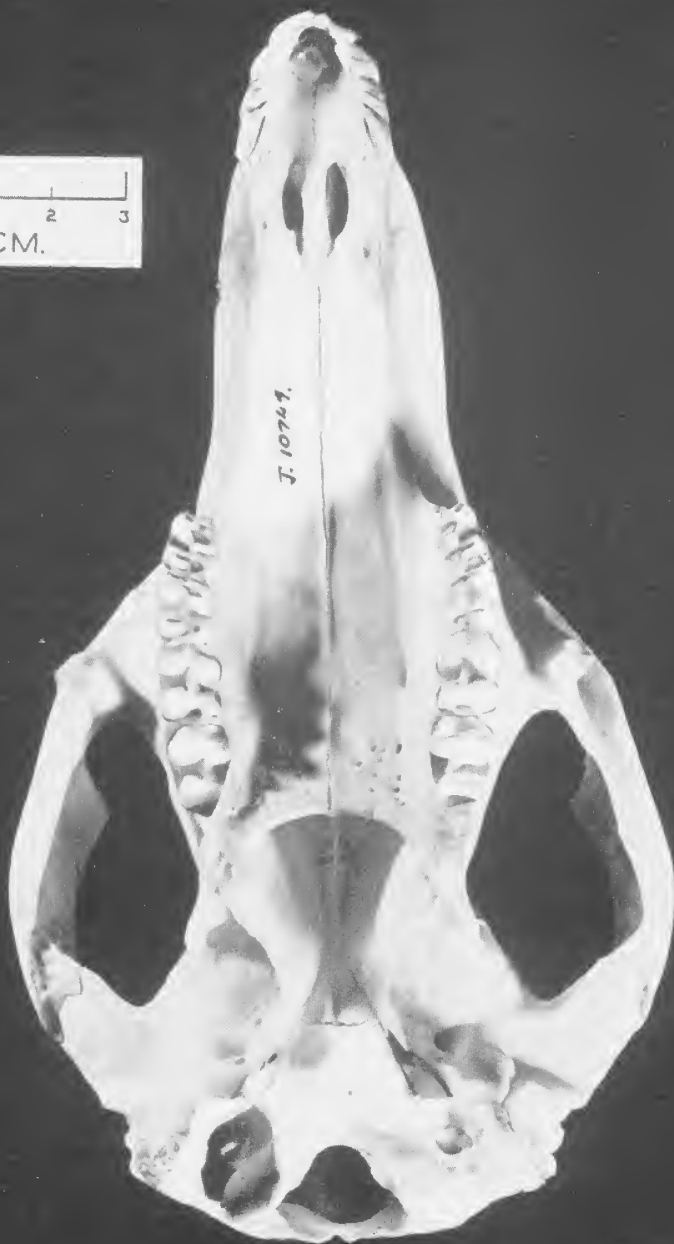
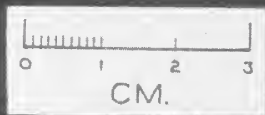
SKULL

● Macropus

♂

Kings Plains, 20 mls. S. of Cooktown, N.E.Q.

Coll: DPVernon and S.Bredden 9.11.60



Queensland Museum

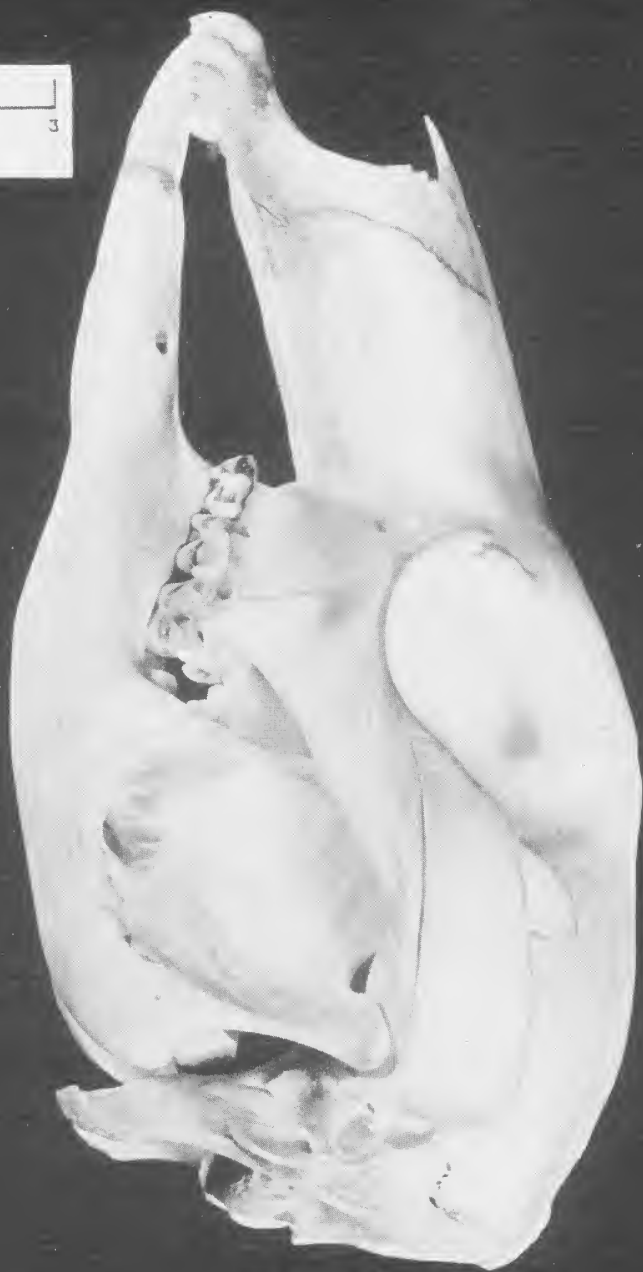
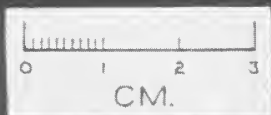
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♂

Kings Plains, 20 mls. S. of Cooktown, N.E.Q.
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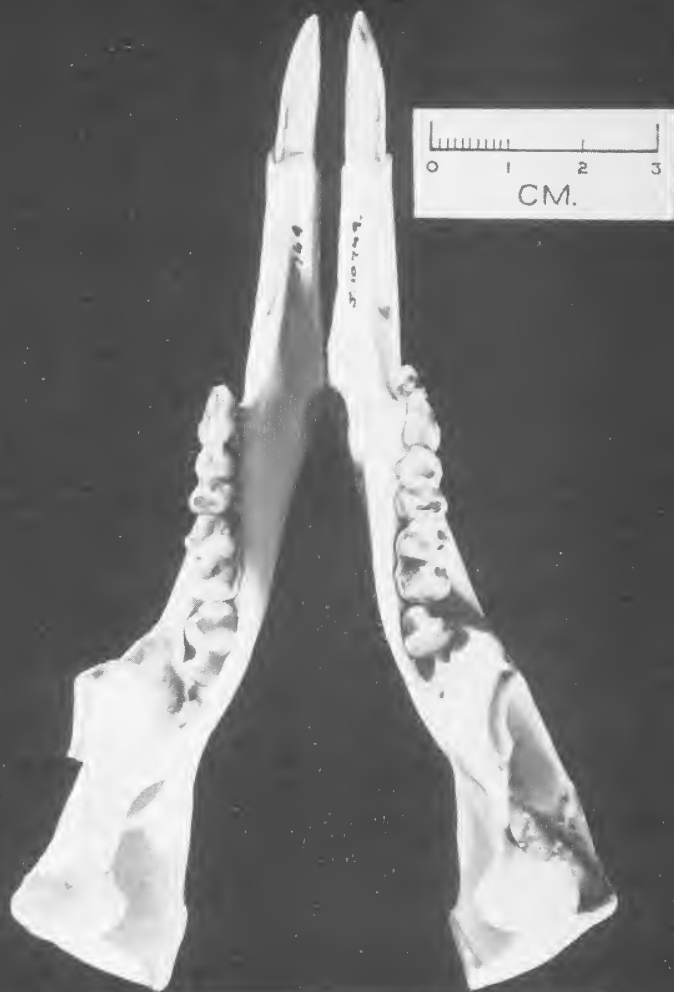
SKULL

Macropus

♂

Kings Plains, 20 mls. S. of Cooktown, N.E.Q.

Coll: D.P. Vernon and S. Brecken 9.11.60



Queensland Museum J10749 Brisbane
SKULL
● *Macropus* ♂
Kings Plains, 20 mls. S. of Cooktown, N.E.Q.
Coll.: DPVernon and S.Breeden 9.11.60



A NEW SPECIES OF THYLACOLEO AND NOTES ON SOME CAUDAL VERTEBRAE OF PALORCHESTES AZAEL

ALAN BARTHOLOMAI
Queensland Museum

The Darling Downs area of south-eastern Queensland consists mainly of extensive fluviatile deposits of Upper Cainozoic Age. Woods (1960) indicated that the Chinchilla Sand, developed in the valley of the Condamine River in the north-western Darling Downs, was probably deposited earlier than the Pleistocene alluvia to the south-east.

Specimens of the genus *Thylacoleo* Owen in the collections of the Queensland Museum were revised by Woods (1956) and those from the south-eastern Darling Downs were attributed to *T. carnifex* Owen. A small proportion of fragmentary material from the Chinchilla district was tentatively separated as possessing features sufficiently distinct to constitute a possible new species. Recently, a partial right mandibular ramus was collected from the Chinchilla Sand at the Chinchilla Rifle Range (Rifle Range Number 78, parish of Chinchilla), supporting the view that the variations are characteristic, and the material is here described as a new species.

All measurements are in millimetres.

THYLACOLEO CRASSIDENTATUS sp. nov.

(Figures 1, 2)

MATERIAL. F.3565, holotype. A partial right mandibular ramus with I_1 broken, $P_3 - M_2$, young adult. Chinchilla Sand, at 363677 Chinchilla 4 mile military map, possibly Pliocene.

Specimens from the Chinchilla Sand at Chinchilla, north-western Darling Downs: F.2957, partial right mandibular ramus, no teeth preserved. F.2961, partial left mandibular ramus with both P_3 and M_1 broken, very aged. F.2962, partial right mandibular ramus with P_3 , adult. F.2960, partial left mandibular ramus with M_2 , aged. F.2964, partial left mandibular ramus with I_1 broken, P_3 , juvenile. F.2963, broken left P_3 , adult. F.2495, partial left mandibular ramus with P_3 , adult. F. 2941, partial right maxilla with both P^3 and M^1 broken, adult. F.2954, partial right maxilla with both P^3 and M^1 broken, adult. F.2955, partial right maxilla with P^3 , adult.

Specimens from the Darling Downs : F.3569, partial right mandibular ramus with both I_1 and P_3 broken, M_1 , adult. F.3570, partial left mandibular ramus with M_1 , adult. F.3571, partial left mandibular ramus. F.3572, partial left mandibular ramus with both P_3 and M_1 broken, aged.

Measurements of Mandibles

Specimen	Length of crown of P_3	Breadth of P_3 above posterior root	Length of crown of M_1	Breadth below metaconid of M_1	Angle between I_1 and base of mandible
Holotype, F.3565	37.0	14.1	15.5	11.3	42°
F.2962	35.6	13.6	—	—	—
F.2964	36.2	13.5	—	—	—
F.2495	41.4	14.3	—	—	—
F.2961	—	—	—	—	39°
F.3569	—	—	13.3	10.0	42°
F.3570	—	—	14.9	10.8	—
F.3572	—	—	15.5	11.5	—

Ramus deep, strong, particularly robust in region of implantation of cheek teeth; longitudinal axis very slightly convex laterally; symphysis unfused; symphyseal plane short, deep, subequilaterally triangular, somewhat upturned. Fossa subalveolaris deep, confluent; mental foramen prominent, ventral to anterior margin of P_3 and antero-dorsal to junction of anterior margin and inferior surface of ramus at blunt angle; lateral alveolar walls of P_3 thinning, roots becoming exposed with age, with simultaneous development of inter-rootial depression. Ramus ascending at low angle posterior to smooth, weak diagastric process ventral to M_2 ; postalveolar ridge not prominent, ascending gradually posteriorly, disappearing on mesial wall of large coronoid process. Process diverging from line of ramus, directed antero-posteriorly; antero-dorsal margin ascending at approximately 45°, grooved, laterally flanged; flange continuing ventrally on body of ramus limiting large, anteriorly deep, ectocoronoid fossa. Wall of fossa perforated by masseteric foramen opening into inferior dental canal close to mandibular foramen. Condyle, postero-mesial angle of ramus and posterior portion of coronoid process not preserved.

Lower median incisor broken, but enough remains to indicate the presence of shallow, posterior longitudinal furrows; lingual furrow best developed. I_1 making an angle of approximately 42° with base of mandible. P_1 and P_2 not retained; alveoli small, mesial to anterior root P_3 . Third premolar elongate, sectorial, very convex laterally, deeply rooted; roots directed somewhat dorso-laterally; base of crown swollen; enamel finely ridged vertically, particularly on lingual surface, thickened to flange on anterior edge; crown broadest above posterior root, not tapered posteriorly, asymmetric, with labial face set at much higher angle than lingual; prominent antero-lingual buttress associated with anterior cuspid. Main surface of wear near planar, developed ventro-lateral to cutting edge. Enamel also removed labially at base of crown. Molar series reduced. M_1 relatively large, subtriangular; anteriorly with metaconid high, flanged, with short longitudinal cutting edge in functional continuity with that of P_3 ; base of crown broad anteriorly due to development of prominent labial buttress; crown posteriorly reduced with low median ridged area and shallow, finely ridged, dorso-labial fossette. Facet of wear developed

in continuation with that of P_3 , and another directed postero-laterally; birooted, anterior root much larger than posterior. M_2 small, with single root partially divided lingually, not functional; crown with shallow, faintly ridged dorsal depression.

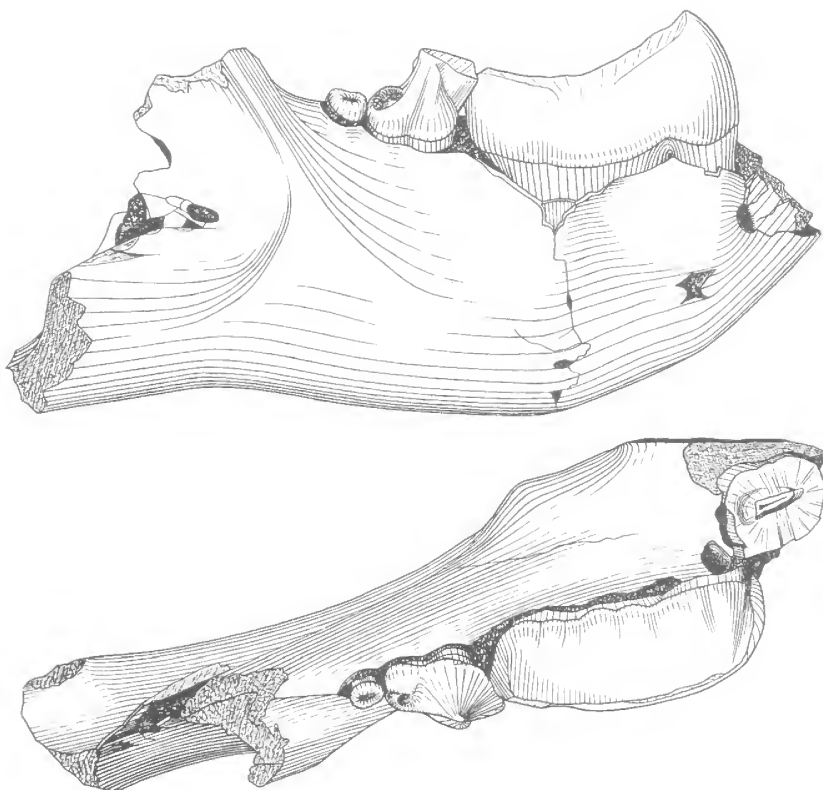


Figure 1. *Thylacoleo crassidentatus* sp. nov. F.3565, holotype. Right ramus, lateral and occlusal views. Natural size.

Woods (1956) compared the fragmentary *Thylacoleo* material from Chinchilla with *T. carnifex* from the south-eastern Darling Downs and discussed the differences exhibited. Although only slight dissimilarities are observed in the maxillary remains, the mandibles differ considerably.

The most significant feature is the structure of the cheek teeth and, in particular, that of the lower sectorial premolar, where the tooth is posteriorly much broader and the longitudinal convexity much stronger than in the corresponding P_3 of *T. carnifex*. M_1 exhibits a difference in relative proportions; it is comparatively stout owing to the greater width above both the anterior and posterior roots. The posterior portion of the crown is comparable with the size of the posterior root and

exhibits a much wider median ridged area together with the development of a shallow, postero-labial fossette. The second molar, although variable developed, is stronger than in *T. carnifex* and its alveolus is partially divided by a vertical ridge on the lateral wall. In one specimen (F.2960), a depression immediately posterior to the relatively large second molar is interpreted as the alveolus of a very small third molar.

In addition, the ramus is much wider in the region of implantation of the cheek teeth and displays a less pronounced longitudinal concavity of the mesial side, while a more recumbent lower median incisor is indicated by the reduction of the angle between the incisor and the base of the mandible.

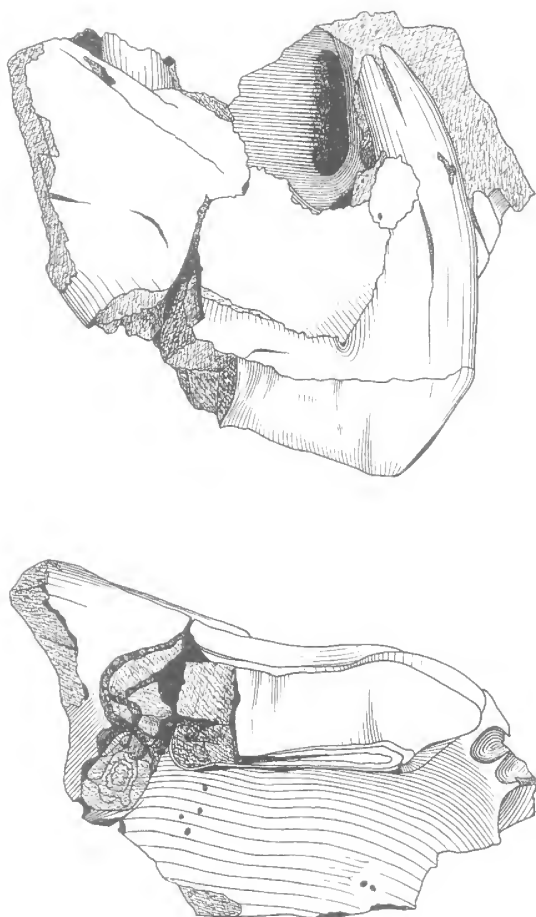


Figure 2. *Thylacoleo crassidentatus* sp. nov. Lateral and occlusal views of maxillary fragment (F.2954). Natural size.

Owing to the fragmentary nature of the preservation of the maxillary material in *T. crassidentatus* relatively few comparative measurements are possible. The third premolars exhibit no features which differ from those of *T. carnifex*. The base of the crown of the first molar in F.2954 is wider than in *T. carnifex*, while in F.2955 the tooth is more distinctly tri-rooted, the anterior root being largest, while the posterior roots are subequal. In addition, F.2954 exhibits a depression immediately posterior to M¹ and this is considered to represent the alveolus of a small second molar.

It is apparent that the molar series of *T. crassidentatus* are much less reduced both in size and numbers than in *T. carnifex*, a fact in keeping with the suggested time relationships of the two faunas.

VERTEBRAE OF *PALORCHESTES AZAEL* OWEN

(Figures 3, 4)

Six caudal vertebrae (F.3564), were recently located in position in the alluvia of "Strathmore" station near Collinsville, north-eastern Queensland, and were presented to the Queensland Museum by Mr. E. Cunningham. Associated with the series is a large number of post-cranial fragments together with an incomplete right mandibular ramus, the lower median incisors, and several maxillary fragments of *Palorchestes azael*. In view of the field association there can be little doubt that the vertebrae, interpreted as representing the first six of the caudal series, belong to this species.

Neural arches and zygopophyses are not preserved in first, fourth and fifth vertebrae, while transverse processes are broken in vertebrae five and six, and are poorly represented in the first. No chevrons are preserved.

DESCRIPTION

Vertebrae large, stout. All centra short antero-posteriorly, broader posteriorly than long and broadest in second. Length decreases from first to the fifth, then increases. Centra broadly convex inferiorly; posterior depth greatest in first caudal vertebra, decreasing regularly to sixth. Epiphyses firmly fused. Floors of neural canals in anterior vertebrae subdivided by median ridges, on either side of which foramina pierce centra; distal centra pierced by one foramen, with median ridges discontinuous. Neural arches moderately high and broad with neural spine quite high in second caudal, decreasing in development posteriorly and barely visible as low ridge in sixth vertebra. Zygopophyses functional in proximal vertebrae but with anterior zygopophyses reduced and functionless by sixth vertebra and with posterior zygopophyses lost. Transverse

processes broadly expanded antero-posteriorly in anterior vertebrae, particularly at extremities, but are rounded at tips; processes decrease in transverse diameter and in antero-posterior expansion to sixth caudal.

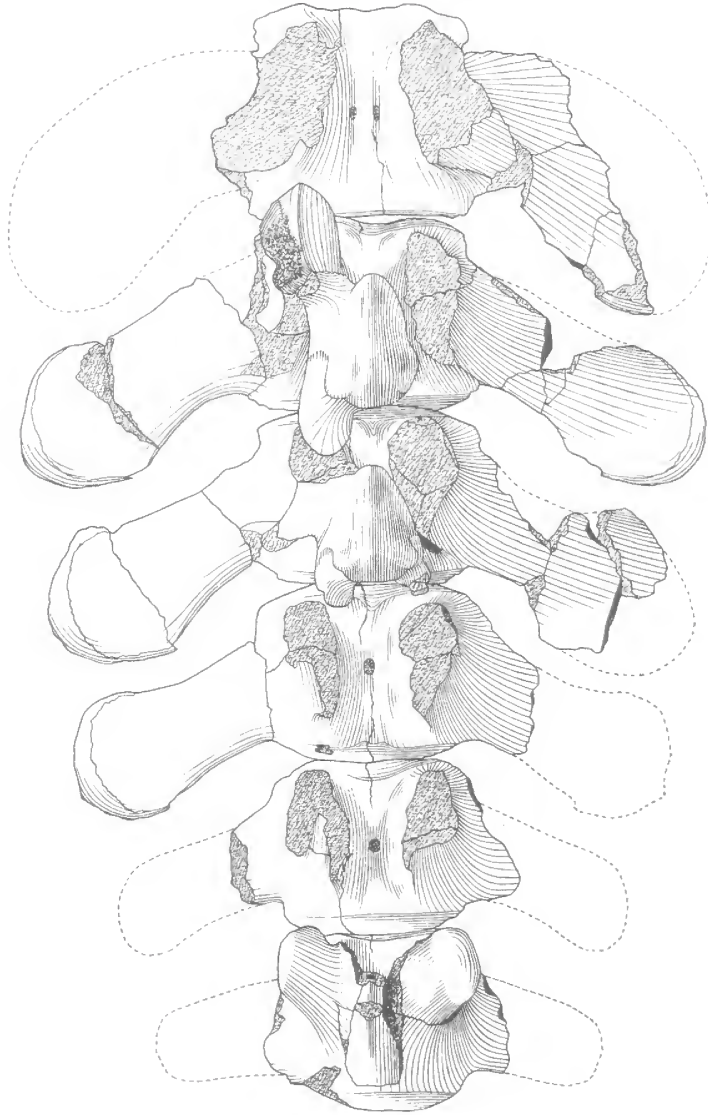


Figure 3. *Palorchestes azael* Owen. Dorsal view of caudal vertebrae (F.3564). One third natural size.

Measurements

Caudal Vertebra					Length of centrum	Posterior breadth of centrum	Posterior depth of centrum	Breadth across transverse process
1	..	..	..	..	79	86	62	—
2	..	..	..	..	71	87	60	272
3	..	..	..	..	68	80	58	247
4	..	..	..	..	66	74	56	236
								(estimated)
5	..	..	..	..	66	70	54	—
6	..	..	..	..	68	69	51	—

In his revision of the species of *Palorchestes* Owen from south-eastern Queensland, Woods (1958) concluded that the genus belongs within the family Diprotodontidae and not within the Macropodidae as indicated by Owen and later workers. The erroneous idea of the systematic position of *Palorchestes* led Owen to attribute a number of post-cranial macropodid remains to the genus. Fletcher (1945) mentioned additional post-cranial fossils referred to *P. azael* in the collections of the Australian Museum, Sydney, but Woods doubted the identification because of the absence of field association. Woods has also indicated that the lower incisor found associated with post-cranial remains from the dune sandstone at Fowler's Cove, Nepean Peninsula, Victoria and tentatively referred by Gregory (1902) to this species, is of characteristic macropodid aspect and referable to one of the large extinct species of *Protemnodon* Owen.

Relatively few of the Australian fossil diprotodontids have their caudal vertebral series sufficiently well known to afford comparisons with those of *P. azael*. The posterior breadths of the proximal centra in *P. azael* and *Diprotodon optatus* Owen exceed the lengths, but while the centra of *D. optatus* are shallow posteriorly owing to the flattening of the inferior surfaces, those of *P. azael* are similar in structure to the macropodids. Gill and Banks (1956) and Scott (1915), show that the centra of *Nototherium tasmanicum* Scott are structurally similar to those of *D. optatus*. The transverse expansion of the transverse processes and the rounding of the process extremities in *P. azael* is similar to that of the other diprotodontids, and is especially similar to that of *N. tasmanicum*. The anterior neural canals, however, are comparable with those observed in the Macropodidae, being high and comparatively broad, but contrasting markedly with the low, very broad neural canals in *D. optatus*. In conjunction with this feature, the zygopophyses in the proximal caudal vertebrae of *D. optatus* are much reduced and functionless, while the neural spines are represented by extremely low tubercles. This is similar to the structure observed in *N. tasmanicum* but is in direct contrast to the well-developed, functional zygopophyses and moderately high neural spines in *P. azael*.

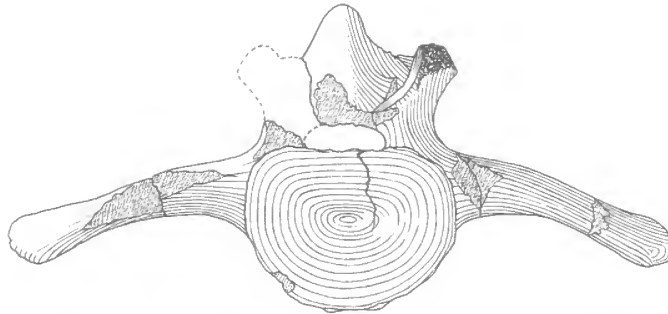


Figure 4. *Palorchestes azael* Owen. Anterior view of second caudal vertebra (F.3564). One third natural size.

Tedford (1959) recorded a palorchestine diprotodontid from the Etadunna Formation of possible Oligocene Age (Stirton *et al.*, 1961), at Lake Ngapakaldi and Lake Kanunka North, Tirari Desert, north-eastern South Australia, and noted that the tail was long and heavy.

The palorchestine diprotodontids were apparently lightly built, more mobile grazing animals than other members of the Diprotodontidae. Although the tail of *P. azael* differs considerably from that of *D. optatus*, it does appear to be structurally closer to that of *N. tasmanicum*. The structural similarities to the macropodid tail are believed to be related solely to body form and are not of general systematic importance.

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FOSSIL MARSUPIALS AND CAINOZOIC CONTINENTAL STRATIGRAPHY IN AUSTRALIA: A REVIEW

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The geological history of the mammals in other parts of the world suggests that marsupials entered the Australian Region and became isolated at an early date, at least by the beginning of the Cainozoic era. However, prior to the discoveries of the last decade, the early palaeontological record of Australian marsupials was most unimpressive, with only one species, *Wynyardia bassiana*, known from lower Tertiary deposits. Their abundance in Quaternary sediments stood in remarkable contrast.

Since then, the work of Professor R. A. Stirton and his colleagues in the eastern part of the Lake Eyre Basin in South Australia has provided a major contribution to the palaeontological record of the marsupials and other vertebrates in Tertiary time. Other significant discoveries have been reported from the Tertiary of Victoria, where the association of some of the fossils with marine beds has enabled more precise dating of the remains. While the bulk of our knowledge is still confined to upper Cainozoic forms, their potential value in continental stratigraphy is apparent. At the same time, the variety of these upper Cainozoic marsupials points to the diversification of the groups in this continent at an early date, and emphasizes that the paucity of the early Tertiary record will have to be overcome before the basic phylogeny of these groups can be established.

TERTIARY

The oldest Tertiary marsupial, the age of which can be stated with any precision, is still *Wynyardia bassiana* from marine sediments at Fossil Bluff near Wynyard, northern Tasmania. The skeleton was originally found in a fallen block of limestone from the "*Turritella* Bed," and the results of the application of the fluorine test, published by Gill (1957), appear to establish that this bed was its true provenance. On the basis of its correlation with the Janjukian Stage in Victoria, an Oligocene age is now generally accepted for the marine section at Fossil Bluff. Following his re-examination of the skeleton, Wood Jones (1931) concluded that the affinities of *Wynyardia* were with the Phalangeridae.

Several fragmentary marsupial fossils have been recovered from shallow water marine beds and from horizons interbedded with marine sediments in Victoria. As our knowledge of such forms increases, their occurrence will provide a basis for correlation of the continental Tertiaries with the marine succession. The oldest of

these remains is portion of a macropodid femur reported by Glaessner, McGowran, and Wade (1960) from sand of Balcombian age (Middle Miocene) above the Bochara Limestone in Grange Burn, near Hamilton, Victoria. Younger marine sediments in the same area, the Grange Burn Coquina of lower Pliocene age, have yielded a fragment of a macropodid mandible, referred by Stirton (1957b) to the subfamily Sthenurinae.

Three diprotodontid fossils originally found on the beach at Beaumaris, Victoria, and described by Stirton (1957b) were shown by Gill (1957) to have a fluorine index comparable with a provenance in the Black Rock Member of the Sandringham Sand. These marsupials then belong to the Cheltenham "Stage" of upper Miocene age.

Details of the stratigraphic succession and additional information on the fauna of the Cainozoic sediments of the Tirari Desert in the eastern part of the Lake Eyre Basin, South Australia, have been recently published by Stirton, Tedford, and Miller (1961). While the stratigraphic relationships of the various units have been established through superposition, the authors have expressed difficulty in assigning them ages in terms of the conventional epochs of the Tertiary. The oldest unit recognised, the lacustrine Etadunna Formation, is tentatively assigned to the Oligocene on the basis of comparative evolutionary studies of the macropodid fauna. The formation postdates the development of duricrust on representatives of the Cretaceous Winton Formation and remnants of early Cainozoic fluvial deposits.

It must be acknowledged that lateritic processes were operative not only over wide areas in Australia, but at more than one time during the Cainozoic. However, Twidale (1956) has postulated that in north-west Queensland uplift and dissection of a widespread lateritized surface, developed on Cretaceous and probable early Tertiary rocks, took place approximately in Miocene time. The surface was apparently of considerable extent in inland Australia, and constitutes the Australian Pediplain of King (1950), the erosion of which, he claims, was initiated by earth movements in late Oligocene or Miocene time. It may well be that a tentative Miocene age for the Etadunna Formation would be more appropriate than a tentative Oligocene age.

The marsupials of the Etadunna Formation recorded by Stirton *et al.* (1961) include a dasyurid, a phascolaretid, *Perikoala*, previously described by Stirton (1957a), two macropodids, and a small diprotodontid with possible palorchestine affinities.

Lithologically the formation is calcareous in part, with some massive limestones carrying chert nodules. Paten (1961) has recently discussed the Cainozoic freshwater limestones and associated sediments, which are widespread in western Queensland, but which show their greatest development in the valleys of the Georgina and Burke Rivers and near Birdsville, all within the present Lake Eyre drainage basin. Their

section usually includes detritus from older lateritized profiles at the base, and silicification frequently occurs towards the surface. Paten has suggested a late Tertiary or early Quaternary age for these deposits. Vertebrate fossils have been recovered from only one locality, in the Carl Creek Limestone, near Riversleigh in the Gregory River valley. This is away from the main occurrences, and the fragmental bones, so far recovered, are unsatisfactory for close study.

It is possible that deposition of calcareous lacustrine sediments took place at different times in the Cainozoic over this whole belt. No correlation of any of these deposits with the Etadunna Formation can be suggested on the available evidence; there is no detailed lithological resemblance, but the similarity in gross stratigraphic relationships indicates that the possibility might be considered in future work.

In the Tirari Desert the next unit recognised by Stirton *et al.* (1961), the Mampuwordu Sands, consist of fluviatile sediments deposited disconformably or possibly unconformably on representatives of the Etadunna Formation. Elements of the fauna of the stream channel deposits, tentatively placed as lower Pliocene in age, were described by Stirton (1955). In the recent work the marsupials of the faunal list now comprise the peramelid *Ischnodon*, four macropodids including *Prionotemnus*, and two diprotodontids, *Meniscolophus* and a form with affinities to *Euowenia*.

Unfossiliferous sandy and argillaceous sediments of the Tirari Formation, which overlie the Etadunna Formation unconformably, are also tentatively referred by these authors to the Pliocene. Fossiliferous Pleistocene sediments, the Katipiri Sands, and younger Quaternary or Recent fluviatile and aeolian sediments complete the succession in the Tirari Desert, the most complete recognised in continental deposits of the Cainozoic of Australia.

To date, elements of the fauna of the Mampuwordu Sands have not been found elsewhere in Australia. Stirton (1955) suggested that *Nototherium watutense*, originally described by Anderson (1937) from the Watut River, New Guinea, was probably referable to *Meniscolophus*. Information from Dow (1961, personal communication) indicates that the New Guinea species occurs in sediments of Pleistocene age, but some occurrences may be older.

Loosely compacted fluviatile and lacustrine sediments which are tentatively referred to the Pliocene are widespread in Queensland. They comprise the Glendower Formation and its lithological equivalents, which are mostly unnamed and unmapped, although the Lynd Formation is known to be extensive in the plains east of the southern part of the Gulf of Carpentaria. Conglomerates containing pebbles of the silicified duricrust, commonly known as "billy," are usually prominent in the section, and the sediments appear to have been derived from the dissection of the extensively lateritized, peneplaned (or pediplaned) middle Cainozoic surface. They,

in turn, often display broad ferruginous mottling, usually interpreted as a weak lateritic effect. There is evidence of broad warping, and in places considerable dissection has followed uplift.

Unfortunately these widespread deposits are usually unfossiliferous, but the prevalence of leached non-calcareous clastics lessens the chances of preservation of vertebrate remains. An exception is the Chinchilla Sand (Woods, 1960) which has been traced on the basis of both lithology and fossil content for a distance of nearly 40 miles in its surface and subsurface extent between Warra and Nangram Lagoon in the north-west of the Darling Downs. The maximum thickness is about 100 feet and calcareous horizons occur. Tortoise and crocodile remains are abundant as well as marsupials in the extensive vertebrate fauna. There is a striking difference between the diprotodontid elements of this fauna and those of the superficial deposits of the eastern Downs. Of these *Euryzygoma* is absent from the presumably younger alluvia, while *Euowenia* and *Palorchestes* are represented by distinct species. However superposition has yet to be established.

A few vertebrate fossils are known from deep alluvia, beneath basalts, in southern Australia. Some of these occurrences are probably upper Tertiary, such as those at Buninyong, Victoria, at a depth of 238 feet (Gill, 1957), and the Canadian Lead at Gulgong, New South Wales, at a depth of 130 feet (Dun, 1895). Freshwater sediments are known to occur below the upper Cainozoic volcanics of north Queensland, but only plant remains have been recovered from them.

Additional localities listed by Gill (1957) for the possible occurrence of Tertiary marsupials in southern Australia include One Tree Point, Hobart, and the Geilston Travertine in Tasmania, the site at Smeaton, Victoria, whence came the dasyurid, *Glaucodon ballaratensis* Stirton, and the lacustrine deposits at Coimadai, Victoria.

QUATERNARY

Vertebrate remains assigned to the Quaternary are widespread in fluvial, lacustrine, and cave deposits, while there are more restricted occurrences in spring deposits, aeolianites, and tuffs. Detailed stratigraphic studies have yet to be made on many of these, and no precise correlation of the various faunas can be made. Indeed, the most comprehensive attempt at a post-Tertiary chronology for Australia is still that of Browne (1945).

While the fragmentary evidence of the upper Tertiary marsupial remains indicates that the major groups were differentiated in this continent by the Miocene, many of them reached their acme in the Pleistocene. The fluctuating climate of that epoch and the consequential rapid changes in the environment no doubt maintained strong selection pressure, especially on browsing and grazing herbivores

of the open forests and grasslands. The possible results, rapid evolution, with increasing specialization, gigantism, and extinction, are all evident in the palaeontological record of the Quaternary.

The occurrence of any fossil marsupials to the north of the Australian mainland is of particular interest, in that information may be gained on the times and directions of dispersal of the various marsupial groups. To date, their occurrence is restricted to the diprotodontid, *Nototherium watutense*, and a few fragmentary undescribed macropodids from the Morobe Goldfields area. Information kindly supplied by Dow (1961, pers. commun.) indicates that these fossils are derived from the Otibanda Lake Beds which were deposited in two lakes in the valleys of the Bulolo and Watut Rivers, separated by extensive andesitic volcanics of the Bulolo Gorge. The sediments of the smaller area near Wau comprise conglomerate, sandstone, siltstone, and mudstone, with interbedded andesitic tuff and agglomerate near the base. A Pleistocene age is considered likely for this sequence. The larger lake, in the valleys of the Watut and lower Bulolo, was formed by faulting and regional uplift in the Snake River area. The presence of andesitic volcanic material, apparently subaerially deposited, throughout much of the section, suggests that in part this sequence may be slightly older. The Otibanda Lake Beds are deformed, with dips up to 45°.

In a small collection recently received from this area the only well preserved specimen is portion of a diprotodontid mandible referable to *Nototherium* sp. Its molar pattern is very similar to *Nototherium tasmanicum* from the upper Pleistocene of Tasmania and the more widely distributed *N. mitchelli* of the Pleistocene. However, this comparison does not assist correlation since the isolated upper premolar figured by Stirton (1957b) suggests that the genus *Nototherium* ranged at least from upper Miocene time.

One of the most intensively collected areas of Pleistocene alluvia in Australia occurs in the valleys of the Condamine River and its tributaries of the eastern Darling Downs. Many of the type specimens of the Pleistocene marsupials described by Sir Richard Owen in the last century were obtained from these deposits. In the eastern part of the area, as in the valley of King Creek, the fossiliferous beds comprise brown calcareous clays with lenticular basaltic gravels at rather shallow depths in the creek sections. Along the Condamine River near Dalby and Macalister, the observed sections are thicker and commonly contain sands and grits as well as brown and grey clays. Bore records show up to 167 feet of alluvia in this area. A general Pleistocene age has been assigned to this sequence by Woods (1960) based on the almost complete absence of living species among the fossils. It is feasible that the more superficial fossiliferous alluvia along King Creek are upper Pleistocene in age, while the thicker sediments in the Condamine valley range back to include equivalents of the Chinchilla Sand.

Marsupials are predominant in this fauna from the eastern Darling Downs ; reptiles are not so common as in the Chinchilla Sand. The most common of the giant marsupials is the widespread *Diprotodon optatus*, and the dominant macropodids are *Macropus titan* and *Protemnodon anak*. The smaller polyprotodont marsupials and the phalangerids are not well represented, but those with a general forest habitat and small size are unlikely to be preserved in the fluvial deposits of wide valleys and plains.

Following the early work of Owen, a large number of fossil marsupials were described from the Darling Downs by C. W. De Vis. His descriptions are frequently unaccompanied by locality and stratigraphic data, and in some cases type specimens were not designated. This applies, in particular, to his work on the macropodids (De Vis, 1895), which deals in composite fashion with collections from both the Chinchilla area and the eastern Darling Downs, and stratigraphic evaluation of many of his species has not been possible. Currently, revisionary work on these forms is being undertaken by Dr. W. D. L. Ride and Mr. A. Bartholomai.

Diprotodon optatus was widely distributed on the mainland, and while it reached King Island, there is no record of its having reached Tasmania. It was apparently adapted to a wide range of habitats ; Gill (1955) records its occurrence at altitudes between sea level and 2,000 feet. The apparent absence of *Diprotodon* from Tasmania may be due to a relatively late dispersal of the genus and the presence of an indigenous species of *Nototherium* (*N. tasmanicum*) as well as the widespread *N. mitchelli* in the Mowbray Swamp Peat, regarded by Gill and Banks (1956) as upper Pleistocene, may be taken as evidence in support of this view. While the restriction of the range of the family Diprotodontidae in southern Australia to the upper Pleistocene or the upper part of the middle Pleistocene as suggested by Keble (1945) is no longer tenable, indications are that most occurrences of *Diprotodon optatus* in this region are in upper Pleistocene deposits. Furthermore, the species is known to range into early Recent time.

However, *Diprotodon* sp. occurs in the Chinchilla Sand, and Owen (1870) recorded the genus from a depth of 100 feet in the Condamine alluvia. Its apparent variation in time range may reflect the local patterns of sedimentation in different parts of the continent.

Two separate faunas have been recognised by Stirton *et al.* (1961) from the Katipiri Sands of Pleistocene age in the Tirari Desert. These fluvial deposits rest disconformably on the Tirari Formation. The presumably older mammalian fauna from Lake Kanunka, tentatively referred by these authors to the early Pleistocene, contains not only marsupials but the oldest rodent known from the Australian Region. The marsupials comprise a dasyurid, a thylacoleonid, two phascolomids including one specimen referable to *Phascolonus*, several macropodids of diverse groups, and diprotodontid fragments, possibly referable to *Euowenia*. *Diprotodon* has not been collected in this fauna.

The other mammalian fauna, placed as late Pleistocene, includes several rodents, as well as marsupials, comprising the dasyurid *Sarcophilus*, the phalangerid *Trichosurus*, the phascolid *Phascolonus*, several macropodids including the still-living *Bettongia lesueuri*, and the widespread diprotodontid *Diprotodon*.

A large assemblage of living and extinct marsupial genera, including *Diprotodon*, has been obtained from the lowest unit of the aeolian sequence at the archaeological site at Lake Menindee (Tedford, 1955). This fauna was contemporaneous with aboriginal man with the Tartangan culture, and radiocarbon dating of the site shows it to be of early Recent age at approximately 6,570 years before the present time (Tindale, 1957). People with the Tartangan culture and those with the earlier Kartan culture both reached Tasmania, so no zoogeographic basis for the failure of *Diprotodon* to reach there is apparent.

Few of the extinct marsupials seemed to have survived the time of the Mid-Recent Thermal Maximum, about 5,000 years ago. The macropodid *Procoptodon* survived until the time of the Pirrian culture of australoid people, about 4,250 years ago (Tindale, 1957). It would appear that the extinction of Pleistocene marsupial species was progressive, not a catastrophic result of any sudden climatic change, although the demands of the fluctuating environment on genetically senile populations were certainly important factors. The arrival of Man probably had a critical effect on certain species, especially those of small numbers in restricted areas.

Cave earths and tufas have yielded abundant fossil mammals, including many not known or poorly represented in other deposits; but these differences largely reflect differences in habitat and mode of accumulation of the remains. Predators, including owls, appear responsible for most of the material. Native rodents and bats are well represented in some occurrences. The assemblages usually comprise a mixture of extinct and living species. While many of the deposits are of upper Pleistocene or even younger age, it is possible that some collections represent material from more than one stratigraphic horizon. Furthermore, the time ranges of many living species of small marsupials have not been established, and the taxonomic evaluation of the fragmentary material often presents difficulties.

Notes on the cave fossils of south-western Western Australia were published by Glauert (1948) and these embody references to his earlier work in the area. A radiocarbon date of > 37,000 years for one of these occurrences, the Mammoth Cave, has been indicated by Ride (1960). In this latter paper the fauna of the Wombeyan Caves, New South Wales, is discussed and regarded as upper Pleistocene in age.

Studies of cave faunas of Recent age in southern Western Australia by Lundelius (1957) show that the geographic ranges of many living species were vastly different in prehistoric time. Very recent material from caves in the Buchan district

of Victoria, listed by Wakefield (1960), is of particular interest in that it includes *Burramys parvus*, previously known only from an assemblage of living and extinct species from the Wombeyan Caves.

As biostratigraphic studies involving our Quaternary mammals proceed, it will be necessary to give special consideration to the local time ranges of species, which vary with time of dispersal and time of extinction. This variation becomes of greater significance with the decrease in age of the fauna.

Mr. Duncan Dow, of the Bureau of Mineral Resources, kindly furnished information on the stratigraphy of the Otibanda Lake Beds, in the Morobe Goldfields area, Territory of New Guinea.

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